

# Flash Drive Integrated Label Free Silicon Nano-Photonic Bio-Assays for Space Station Bio-Diagnostics, Phase I

Completed Technology Project (2018 - 2019)



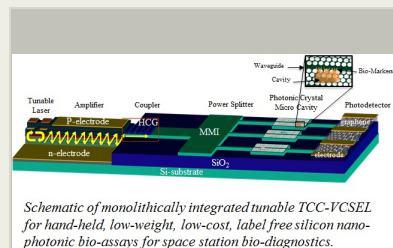
## Project Introduction

Here, Omega Optics Inc. (OO), in collaboration with University of Texas (UT), Austin and Texas A&M University will develop a novel label-free photonic crystal (PC) micro-cavities based on-chip integrated electrically injected tunable transverse-coupled-cavity (TCC) vertical-cavity surface-emitting lasers (VCSELs) for high throughput diagnostic assays in early cancer detections. The device will enable low cost of ownership (COO) \$50-\$100 for consumable parts and measurement system is expected to be less than \$1000. High sensitivities of less than 67 femto grams per millimeter is expected. It is noted that each PC cavity is immobilized with a unique capture biomolecule, and interrogated simultaneously for binding between the probe capture and target biomolecule. Binding is manifested by change in resonance wavelength due to the change in refractive index. Large effective modal volume and high quality factor of the resonance enables the optical mode to interact with more biomolecules for a longer interaction time thereby leading to high sensitivity compact sensors. Binding specificity is achieved by sandwich assay techniques combined with multiplexed detection for statistical confidence. Electrical injection enables chip integration of the light source that offers superior advantage over all existing optical sensors which rely on coupling of external optical sources with complex instrumentation. The device can be easily extended to any multi-analyte sensing for implementation in biomarker discovery, drug discovery, health diagnostics and in the long term, in screening. Market for cancer profiling technologies market is to be \$54.8 billion in 2018, while the pharmaceuticals market is expected to grow to \$1 Trillion. We expect to occupy a significant position in the above markets. Our technology is extremely versatile and the ramifications are far-reaching.

## Anticipated Benefits

Can be used for: (1) Monitoring the astronaut's health from irritable bowel syndrome to diabetes, and even depression. Stressful conditions, like those typically found during a space mission, including cosmic radiation and microgravity, have been shown to changes in bacterial physiology. Due to hand-held and label free it can be used anywhere, anytime. (2) Also our tunable laser integrated with amplifier can be used for NASA's LIDAR applications.

It can be used for (1) early detection in the medical diagnostics, (2) Bio-"warfare defense" assays monitoring biological toxins, food and feedstock assays . Away from the sensing market, electrically injected tunable TCC-VCSEL and semiconductor optical amplifier have dominant markets in (3) chip-integrated low-threshold with tunable operation for optical communications. Hence, diverse areas of science and technology are expected to benefit from this research.



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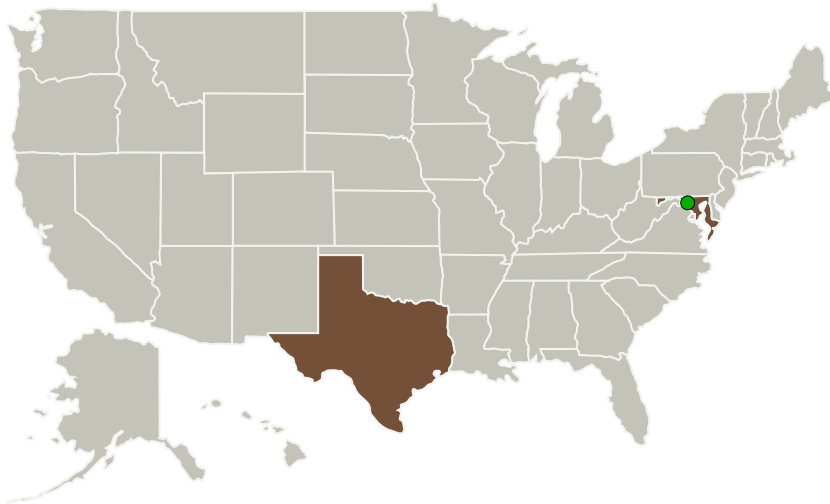
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Omega Optics, Inc.	Lead Organization	Industry	Austin, Texas
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
The University of Texas at Austin	Supporting Organization	Academia	Austin, Texas

## Primary U.S. Work Locations

Maryland	Texas
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## Project Transitions

**July 2018:** Project Start

**August 2019:** Closed out

## Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/141342>)

TechPort

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For more information and an accessible alternative, please visit:  
<https://techport.nasa.gov/view/94588>

## Organizational Responsibility

## Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

## Lead Organization:

Omega Optics, Inc.

## Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

## Program Director:

Jason L Kessler

## Program Manager:

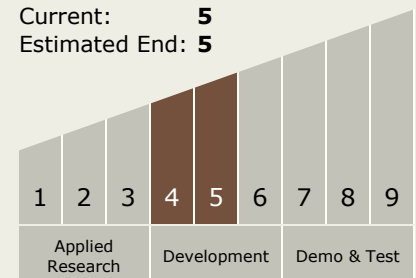
Carlos Torrez

## Principal Investigator:

Hamed Dalir

## Technology Maturity (TRL)

Start: 4  
Current: 5  
Estimated End: 5

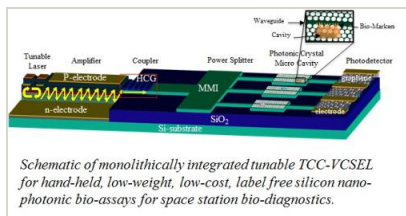


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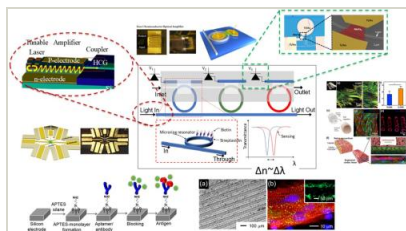
## Images



### Briefing Chart Image

Flash Drive Integrated Label Free Silicon Nano-Photonic Bio-Assays for Space Station Bio-Diagnostics, Phase I

(<https://techport.nasa.gov/image/130139>)



### Final Summary Chart Image

Flash Drive Integrated Label Free Silicon Nano-Photonic Bio-Assays for Space Station Bio-Diagnostics, Phase I

(<https://techport.nasa.gov/image/130156>)

## Technology Areas

### Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.3 Human Health and Performance
    - └ TX06.3.1 Medical Diagnosis and Prognosis

## Target Destination

Earth